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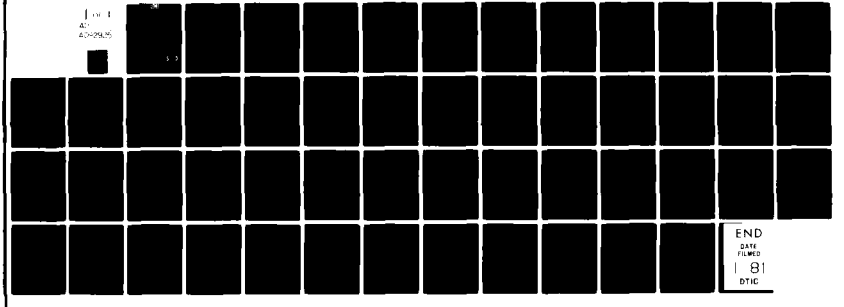

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COMMAND CONTROL, AND COMMUNICATION FOR THE AH-64 WITH HELLFIRE

A THESIS PRESENTED TO THE FACULTY OF THE
U. S. ARMY COMMAND AND GENERAL STAFF COLLEGE
IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE
MASTER OF MILITARY ART AND SCIENCE

BY
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B.S. UNIVERSITY OF NEBRASKA, OMAHA, 1972

FORT LEAVENWORTH, KANSAS
1980

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A011 925
3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Command, Control, and Communication for the AH-64 with HELLFIRE	5. TYPE OF REPORT & PERIOD COVERED 6 June 1980
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Grimsbo, Robert G., MAJ, USA	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Student at the US Army Command and General Staff College, Fort Leavenworth, Kansas 66027	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Command and General Staff College ATTN: ATZLSW-DC-MS	12. REPORT DATE 6 June 1980
	13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

Approved for public release; distribution unlimited.

18. SUPPLEMENTARY NOTES

Master of Military Art and Science (MMAS) thesis prepared at CGSC in partial fulfillment of the Masters program requirements, US Army Command and General Staff College, Fort Leavenworth, Kansas 66027.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

This thesis investigated the feasibility and the need for a digital communication link between the advanced attack helicopter with the HELLFIRE missile and the field artillery's fire control network.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This study examined the feasibility of and the need for a communication link between the advanced attack helicopter employing the HELLFIRE missile and the tactical fire direction system. It also examined the feasibility of and the need for forward observers using a laser designator to fire HELLFIRE missions on the battlefield. During the investigation current Army doctrine for the employment of attack helicopters and their mission on the battlefield was scrutinized as an adjunct to the first two items.

The study found that the technology available in the near future and the present force structure maximize the effectiveness of the HELLFIRE missile system. It also determined that the current threat the Warsaw Pact nations are posing in central Europe contains a formidable array of air defense weapons that can be used against the attack helicopter.

The study determined also that to closely control, fully integrate, and capitalize on the HELLFIRE's enhanced capability, new command, control, and communication procedures must be implemented.

The study concluded that there is a definite need for a digital communication link between HELLFIRE, TACFIRE, and FIST. It concluded that the fire support channels of communications should be the means to integrate HELLFIRE's additional range and seeker capabilities into the overall battle plan, i.e., how attack helicopters can add combat power to the battlefield prior to the enemy's weakening our defense or committing himself to the main attack. The study also concluded that there is a need for forward observers to fire HELLFIRE missions and use laser designators to allow both the attack helicopter and the scout to remain masked during the engagement sequence. Finally the study recommended that current tactical doctrine in both defensive and offensive operations be reexamined for the advanced attack helicopter prior to its being fielded.

COMMAND, CONTROL, AND COMMUNICATION FOR THE AH-64 WITH HELLFIRE

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6 June 1980

A Master of Military Art and Science thesis presented to the faculty of the US Army Command and General Staff College, Fort Leavenworth, Kansas 66027

MASTER OF MILITARY ART AND SCIENCE
THESIS APPROVAL PAGE

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TITLE OF THESIS COMMAND, CONTROL, AND COMMUNICATION FOR THE AH-64 WITH HELLFIRE

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The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency.

ABSTRACT

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CONTENTS

CHAPTER 1

INTRODUCTION AND BACKGROUND

INTRODUCTION

The dynamic battlefield of tomorrow, which will be dominated by threat armored vehicles, indicates that the advanced attack helicopter (AAH) along with its armor killing capability is a weapon system that will rapidly influence the battle. To maximize the effectiveness of this armor killer, its potential must be closely controlled and carefully integrated into the commander's maneuver and fire control plans.

In view of the complexity of the battlefield of the future and the advent of "Division 86," how should we employ and control the fires of the AAH with HELLFIRE to optimize target servicing and offer the greatest protection to the aircraft and crew? What communication system will enable the "battle captain" to handle, analyze, and prioritize the large amounts of target data available; resolve; and hand-off targets to the proper system without duplication?

To analyze these requirements, the current doctrine and a feasibility study for a proposed conceptual system must be evaluated. A determination must be made as to whether existing systems, proposed systems, or a new concept must be adopted and how the selected alternative should be implemented.

NEED FOR THE STUDY

The US Army is currently undergoing a revolution in its force structures, technology, and doctrine. A major component of this revolution is the AAH and its employment. The gamut of concepts, tests,

and analyses, ranging from modes of autonomous laser designation with direct fire to radio frequency/infrared (RF/IR) homing "fire and forget" modes, has been accomplished. The principal precision guided munition for the AAH is the HELLFIRE missile, inasmuch as such a combination can increase the operational effectiveness of the force while in the defense approximately twofold.

The Required Operational Capabilities (ROC) for the Advanced Scout Helicopter (ASH) is being staffed. When fielded, the ASH will be equipped with the target acquisition designation system (TADS) and provide a means of laser designation for the AAH and other precision guided munitions. The field artillery fire support teams (FIST) are currently in the process of being outfitted with a ground laser locator designator (GLLD), which is to be used to designate for COPPERHEAD.[2] The FIST will use a digital message device (DMD) to interface and exchange data with the Tactical Fire Direction System (TACFIRE).

This study will propose command, control, and communication (C3) techniques to enhance the management of fires and to optimize their effectiveness on the battlefield.

PURPOSE OF THE STUDY

The purpose of the study is to determine:

If there should be a communication link between the advanced attack helicopter for HELLFIRE and the computerized TACFIRE as part of the airborne data transfer system.

If there is a requirement for ground laser locator designator (GLLD) operators to hand-off or fire HELLFIRE missions in a direct fire or indirect fire role.

How the US Army's current doctrine for the employment of attack helicopters must be modified to capitalize on the enhanced capabilities of HELLFIRE.

METHODS

The principal research methodology used is a descriptive and subjective analysis supported by data derived from completed and on-going studies from the field. An appropriate comparative analysis between proposed and current doctrine is made. These results and evaluations are considered, categorized, and interpreted for summarization.

ASSUMPTIONS

There are four inherent assumptions in the study:

1. The airborne data transfer system (ADTS) is to be purchased and fielded.
2. Technology today can support any systems proposed in the study.
3. There is no cost and operational effectiveness analysis (COEA) available to support or refute the proposed concept.
4. The proposed concept does not substantially impact on the current logistic or personnel system.

LIMITATIONS

This study does not address the impact of any additicnal training program, logistic support, or personnel support requirements. The funding of any additional systems is not considered, and operational testing (OT) does not occur. This is a concept feasibility study.

FORECAST OF SUBSEQUENT CHAPTERS

Chapter 2: Review of related literature on the AH-64, HELLFIRE, FIST, and TACFIRE.

Chapter 3: Operational threat analysis to the systems under discussion.

Chapter 4: Discussions and findings.

Chapter 5: Conclusions, recommendations, and suggested areas for future consideration.

BACKGROUND

At the present time there is a myriad of concepts and doctrines on the employment of the AAH coupled with HELLFIRE. The most accepted at this writing is that the attack helicopter team (AHT) is a combat maneuver element capable of rapid lateral movement on the battlefield to reinforce the ground commander's plan. In the defense, the AHT attacks the front, flanks, or rear by applying continuous pressure by fire. In the offense it can be used by the "follow and support" force to attack enemy armor strongpoints, to assist in the penetration, or protect the enveloping force. Attack helicopter units can also be employed at those "golden moments" to breakthrough or go around the first echelon of the combined arms army and divisions and interdict second-echelon elements.

The battlefield managers must have a system or technique for employing the weapon platforms to fully exploit the lethality of the HELLFIRE.

The total effectiveness of HELLFIRE is directly dependent on close coordination between the GLLD or the TAD operator when used in the indirect mode. Currently the communication link between the scout or forward observer is FM voice. As found in the communication experiment for HELLFIRE,[3] the average time on the air exceeded 100 seconds, which is entirely too long for responsiveness and survivability.

Threat technology will not permit lengthy conversations on FM radio with any expectation of survival. The scene is so fluid and mobile that coordination must be short and rapid.

Another problem that exists in battlefield management of target servicing is firepower coordination. Currently the FIST structure in the field artillery handles such coordination for the maneuver commander, but the firepower of the AAH is planned, allocated, tasked, and coordinated through maneuver channels.

With the innumerable theories and "mind sets" in the Army today regarding the command, control, and communication (C3) requirements of the AAH, it will be worthwhile to examine a system that best employs and coordinates this weapon for the battlefield managers.

CHAPTER 2

RELATED LITERATURE REVIEW

A requirement exists to examine the capabilities of each component of this study to determine how they can be tied together for more efficient utilization.

ADVANCED ATTACK HELICOPTER (AH-64)

The AH-64, developed by Hughes Helicopter, is a dual pilot, twin-engined helicopter specifically designed to defeat armor and provide area suppression during the day and night and under adverse weather conditions. It possesses a four-bladed, three-point gear system that is powered by twin T-700 General Electric turbine engines rated at 1560 shaft horsepower each.

Helicopter measures of performance are rated by vertical rate of climb (VROC). At 16,000 pounds gross weight on a European hot day, the AH-64 can climb at 800 feet per minute. It has an endurance of 2 hours and 15 minutes and a range of 480 kilometers.[4]

The navigation system of the AH-64 is inertial, can pinpoint the aircraft's location within 10 meters on the ground, and provide a digital printout for ease of interpretation and reduced pilot fatigue.[5]

The aircraft is equipped with a target acquisition designation system (TADS) and a pilot night vision system (PNVS). It has direct view optics, forward looking infrared radar, television, and a laser designator/range finder/laser tracker system, all of which provide day/night/adverse weather target acquisition, designation, and a nap-of-the-earth flight ability that enable a more effective launch of its weapon systems.[6]

For firepower, the AH-64 is equipped with the HELLFIRE missile in the direct or indirect modes as the primary point target weapon. For area suppression, it is equipped with the 30-mm chain gun and 2.75 inch free flight aerial rockets (FFAR). It can carry 16 HELLFIRE missiles, 76 FFAR, 1200 rounds of 30-mm ammunition or a combination of all three, depending on density altitude.[7]

For voice communications, the AH-64 is equipped with standard FM, UHF, VHF radios. Also, it can be equipped with the automatic target hand-off system (ATHS), although it is not available for the second series of tests on the AAH. A follow-on system that will provide a digital interface capability will be the airborne data transfer system (ADTS). When fielded, this system will provide a method of close coordination between designator and launcher that is electronic warfare (EW) resistant.[8]

The improved design for the AH-64 (rotor, canopy, tail rotor, exhaust and fuselage) has enhanced survivability significantly by reducing detectability. Improved crash worthiness features have been included also to increase crash survivability rates for the crew to 95 percent with an impact rate of 42 feet per second.[9]

Because of its high mobility, the AH-64 can be used to attack enemy flanks or rear. This mobility permits the attacking commander to:

Provide flank protection

Concentrate firepower at the point of decision

Progress rapidly in the exploitation and pursuit

Break through in those "golden moments" to perform interdiction missions against second-echelon elements

In the defense, it provides:

Added combat power at critical moments on the battlefield to rapidly reinforce against the breakthrough

Assistance in attacking the flanks of enemy forces

The capability to carry out various security missions

In scenarios drawn from the TRADOC Scenario-Oriented Recurring Evaluation System (SCORES) Europe 1 Sequence 2a, it was proved that adding AAH with precision guided munitions to the ground force structure, the operational effectiveness of the force while on the defense increased approximately twofold. If the modern battlefield is a target rich environment, employment of the AAH can result in an armor vehicle kill vs AAH loss ratio of approximately 50:1.[10]

HELLFIRE

The HELLFIRE system elements consist primarily of:

Pilot status and control panel

Copilot gunner controls and displays

Modular rail launcher

Airborne/ground designator/locator for target illumination

HELLFIRE modular missile

The HELLFIRE modular missile component sections include:

Propulsion

Control

Warhead

Seeker

The HELLFIRE missile offers a variety of options during employment under various conditions, utilizing the different types of seekers. These

guidance and firing options are the laser seeker, infrared image seeker (IRIS), and the radio frequency/infrared (RF/IR) seeker.[11]

The remote laser mode provides the launch-and-leave capability for the AAH. The scout helicopter pilot or the ground laser locator designator (GLLD) operator (forward observer) designates the targets. While the AAH is in a firing position the pilot and the remote designator operator coordinate target location, launch method, lock-on option, firing technique, and designation start time. The AAH then unmasks, launches, remasks, and leaves while the designator illuminates the target during terminal homing. The laser seeker device then searches for laser energy matching the code set in the missile, locks on the proper code, and homes to this reflected energy source.

If a remote designator is not available, the AAH has the capability for autonomous designation, although such action significantly increases its vulnerability.

HELLFIRE can be launched by the direct, pseudo-direct, or indirect method. The direct method can use a lock-on-before-launch or a lock-on-after-launch seeker option. Using the indirect method, the AAH can completely eliminate the possibility of being detected by enemy radar. In this mode, the missile is launched while the aircraft is masked and then a scanning seeker locates and locks on the remotely designated target. The laser mode also possesses rapid and ripple options for employment against massed targets.

The infrared seeker module is launched by the direct method, which allows the missile, while in flight, to seek contrasting heat sources and home onto a target by virtue of the thermal energy it emits, thereby allowing a fire-and-forget engagement.[12]

The launch and forget RF/IR option is employed directly. This seeker detects radio frequency emitters during the first phase of its flight, then transfers the homing function to the thermal radiation seeking mode prior to impact to destroy the vehicle and not, say, the radar disk radio frequency emitter.

The range of the HELLFIRE is approximately 5 to 7 kilometers. The HELLFIRE can be employed to increase tactical flexibility by utilization of a continuous pressure concept or mass firepower concept, which will allow one helicopter to effectively engage ten tanks in approximately 1 minute at these ranges. The ease with which HELLFIRE can be rearmed increases operational flexibility in a high-pressure tactical situation.

To give HELLFIRE more flexibility and increase its potential for massed firepower, there must be a significant number of remote laser designators available on the battlefield. The fire support team (FIST) has the capability to contribute to this need.

FIST

The FIST concept placed such a capability in the Army's force structure to maximize integration of fire support and maneuver, with emphasis at company level. The implementation of this concept has had tremendous acceptability throughout the Army and has gained much praise for its ability to optimize and integrate fire support.

The FIST acquires targets and engages them with all types of indirect fire support. It functions as the eyes of the artillery by reporting battlefield intelligence and surveillance. The FIST chief serves as the company fire support coordination (FSCOORD) and plans and advises on capabilities and limitations of various fire support means available.

The FIST must be able to communicate with all supporting agencies and provide control for close air support.

The FIST is composed of a headquarters and platoon-sized FO parties. It combines all observer assets for overall support of the maneuver company. The FO parties provide continuous observation throughout the company zone and call for all fire support means available, when appropriate.

Transportation available to the FIST depends on the type of company it supports. The FO parties depend on the vehicles organic to the supported platoon. The FIST headquarters has a vehicle similar to that of the supported company. The FIST is being equipped with vehicle position determining equipment, a laser rangefinder, and a ground vehicle laser locator designator, which allow the FIST to engage hard point targets with laser guided munitions, accurately locate area targets, fire for effect with first-round accuracy, and conduct one round adjustments. The FIST is equipped with the digital message device (DMD) that allows observer interface with the TACFIRE system. It transmits and receives in digital bursts over any standard Army communications equipment. The DMD facilitates informal fire support planning by allowing the FIST to transmit planned targets to the battalion FSO via TACFIRE, where target duplication is resolved. The same process is implemented by the brigade FSO, where further duplication is resolved. Management of the expected battlefield target array is accomplished through the pyramid structure of FIST. The entire process--from detection to decision to first rounds on the way--is expressed in seconds because of restructuring and automation.[13]

TACTICAL FIRE DIRECTION SYSTEM (TACFIRE)

The TACFIRE is an automated fire planning and management system that provides the maneuver commander with a fire support system capable of detecting targets, allocating firepower, and opening fire within seconds. This highly automated equipment permits the rapid and accurate determination of target data and transmission of that data to the command and control team. It also sorts out and analyzes target intelligence and defines possible targets for engagement. TACFIRE optimizes the selection of the right means to engage a specific target with, and prepares responsive fire plans for, support of the maneuver force.

In addition to the tactical and technical control functions involving field artillery, TACFIRE is also capable of:

Planning conventional, chemical, and nuclear fire

Processing and disseminating of artillery and target intelligence

Executing fire support functions pertaining to the integration of close air support into fire support planning

Through a "message of interest" function, information is transmitted to other computer centers or remote terminal equipment such as the DMD the FIST possesses or the Variable Format Message Entry Device (VFMED) the various fire support elements within the division possess. This function is an invaluable tool in the fire support coordination process. Targets can be prioritized according to the potential threat; duplications can be resolved; and all weapon systems and munitions available can be considered to defeat the threat.

One of the most beneficial features of TACFIRE is the ability of the equipment to convert standard messages to digital messages that are

transmitted over standard, contemporary AM, FM, or wire in a fraction of the time previously required. TACFIRE computers, VFMEDS and battery display units (BDUS) automatically encrypt and/or decrypt messages using standard Army Comsec equipment. The DMD is not secure although plans are now to include it in the secure mode of operation by FY 1982.

TACFIRE is designed for interaction with new systems and has been built to accommodate these systems. There are a number of communication items currently being designed and fielded to integrate with TACFIRE in order to have a more effective fire support team. Items which can or will communicate with TACFIRE include target acquisition radars AN/TPR-36 and AN/TPG-37, a sound ranging system (FAALS), airborne intelligence collection equipment (SOTAS), and remotely piloted vehicles (RPV).[14]

CHAPTER 3

THE THREAT

"The Soviets possess a formidable and diversified array of integrated armored warfare systems and the support elements for sustained operations. Their main strength lies in the large numbers of their armored vehicles. The Soviets are convinced that the enemy can be defeated only by ground action which fully exploits the results of nuclear strikes or massed conventional artillery fires, and that the combined arms concept of armor and mechanized infantry provides the only practical combination of fire-power, mobility, and protection by which this exploitation can be accomplished."[15]

Past Soviet military doctrine has emphasized general nuclear war. In recent years, however, the trend has been toward strictly conventional warfare with the threat of nuclear options only when the situation is escalated to the point at which enemy intentions or their actual employment of nuclear weapons leaves them no other choice. Once nuclear war has been initiated the Soviets view major offensive nuclear strikes by their Rocket Forces and aviation assets followed by swift exploitation by their armored and airborne forces to secure strategic objectives. The fluidity of battle requires all units to be capable of rapid movement under all weather conditions: day or night.

The Soviets envision three types of offensive operations: the meeting engagement, the attack of a defending enemy, and the pursuit.[16]

The meeting engagement is a clash between two forces, usually one or both of which are moving. It may involve forces from divisional to battalion size. The Soviet commander has the objective of destroying or

bypassing the enemy, and continuing to his subsequent objective. In the meeting engagement Soviet doctrine calls for the force commander to attack exposed flanks and subsequently the rear of his enemy and cut off his lines of communications, thereby isolating him on the battlefield for destruction.

There are two types of attack the Soviets employ against a defending enemy; the hasty and deliberate. In the hasty attack, the unit will deploy and attack from the march without halting. The Soviets believe the surprise achieved over their enemy offsets the hasty coordination required. When the hasty attack has failed or no exposed flanks or gaps are available, the commander may then decide to conduct a deliberate attack. This type of operation requires extensive planning and concentration of artillery. At division level a concentration of forces on a narrow frontage, 4 to 8 kilometers, with as much as 400 artillery pieces in support is typical. The artillery function is to create a breakthrough window by the use of the preparation, which can last up to one hour. This window allows the passage of ground forces rapidly into the enemy's rear. The pursuit then is used to complete the destruction of the enemy.

There are basically three forms of pursuit; the frontal, the parallel, and the combination frontal/parallel. The preferred and most effective form is the combination frontal/parallel which maintains pressure on the retreating enemy and moves forces along routes parallel to the enemy's retreat. The force commander tries to outdistance his enemy blocking them and then cutting the withdrawing column into segments, destroying them piecemeal. The plans for a pursuing force are made well in advance and are extremely detailed in nature. The pursuit is normally conducted by

regimental or higher level commands and only terminated by the combined arms army commander or higher.

The Soviet commanders above battalion level are given zones of action. Battalions are usually assigned directions of attack. These zones are maintained throughout the operation and are a function of the terrain, forces available, and the mission of the unit. Normally an operation is divided into phases based on assigned objectives with first and second echelon formations. These echelons are supported by certain specific reserves usually of a combined arms nature with artillery given a mission to support the reserve when committed.

The first echelon of a Soviet force is required to accomplish the immediate objective and, if capable, continue the attack to the subsequent objective or the "mission of the day." The first echelon will normally contain two or three regiments depending on terrain and width of the assigned zone. The mission of the second echelon is to exploit the success of the first echelon, then to continue the attack. When the first echelon is bogged down or stopped, the second echelon will be committed in order to maintain the desired high tempo of the offense. Other missions the second echelon can perform are reinforcing the main attack, repelling counterattacks, destroying by-passed forces and replacing first echelon units when necessary.[17] Distances between echelons are generally:

Between first and second echelon division: 15 to 30 km.

Between first and second echelon regiments: 5 to 15 km.

Between first and second echelon battalions: 1 to 3 km.

Soviet divisions moving to contact will be deployed in multiple columns on two routes. An advanced guard will be deployed on each route. This advanced guard is usually a reinforced battalion and will operate within

artillery range of the main body. The mission of the advanced guard will be to destroy the covering force or force the covering force to withdraw to allow the main body to remain in march column and not slow down the rate of advance.

Upon making contact with the enemy the advance guard will conduct a hasty attack. If unable to destroy the enemy he then will try to fix the enemy and attack it by fire while the main body attempts to maneuver to the flanks. During the covering force battle, reconnaissance elements are dispatched well forward in an attempt to locate the enemy's main defensive position and report gaps or assailable flanks. Every attempt is made to not deploy the main body from the march column prior to making contact with the enemy's main defense.

A hypothetical array of Warsaw Pact forces which the U.S. V Corps could initially be faced with in the event of hostilities could be described in a manner such as depicted below.

The Soviet forces could be a tank army (TA) with four tank divisions (TD) and one motorized rifle division (MRD). This TA will be conducting a supporting attack for the front with the front's main attack being conducted across the north German plain (Cologne complex axis). The front's mission will be to seize the Saar/Ruhr industrial complex and the TA mission will be to seize crossings over the Fulda River then over the Rhine River in the vicinity of Mainz. The TA will attack with three tank divisions on line with one second echelon tank division following the center division of the first echelon which will conduct the main attack. The MRD will follow the northern first echelon division. The front will have a CAA of two MRD's and one TD positioned approximately 150 km behind the first echelon TA with the ability to reinforce in 12 hours. Each first

echelon division will control its own advance guard of regimental size. The advance guard's mission will be to clear a path through the covering force allowing unimpeded advance of the main body and to locate any weak points or gaps in enemy defenses. The advance guard will have a 152-mm artillery battalion and a four Hind D attack helicopter flight in support. At the company level a U.S. company/team from a mechanized infantry brigade will face a Soviet reinforced tank battalion. The company/team will consist of eight MICV's, five tanks, four TOW's, and six DRAGON's, while the Soviet tank battalion will have 40 tanks, ten BMP's, one BTR 60 command vehicle, one BRDM scout, and four air defense vehicles. The U.S. brigade will have one attack helicopter platoon OPCON and one 155-mm howitzer battalion in direct support.

The threat to heliborne operations from this formidable Soviet force takes on many facets. From the ground forces themselves the 100-mm anti-tank artillery has the possibility of being used against helicopters. The T-64 and T-72 tanks have 12.7-mm AA machineguns mounted on the turrets. These weapons can fire at 600+ RPM with a range of 1-2 km. They can use the tanks main gun firing HE for a harassing effect against rotary wing aircraft. The threat force organization places anti-aircraft weapons, both crew served and individual, down to the battalion sized units. These and the various surface-to-air missiles are the prime source of AA fire. Soviets also train for individual and crew served weapons to be employed against aircraft.

When engaged by an aircraft the T-64 and T-72 button-up, increase their rate of march and engage the aircraft remotely with the hatches closed. Use of self-generated smoke from the tank can be used to screen

the movement of the formation. It must be noted that armored formations orient primarily on the ground objectives and prefer to leave the aerial threat to organic air defense and the air force umbrella.

This umbrella at Front and Army levels emphasize zone coverage at low/medium and medium/high altitudes with surface-to-air missiles and anti-aircraft artillery. Typically a CAA or TA may cover an area 50 km wide and 100 km deep. Air defense units assigned to Front and Army include brigades or regiments of SA-2 Guideline and SA-4 GANEF missiles.

The divisions, both MRD and TD, have an organic air defense regiment which provides medium altitude coverage. They may possess the S-60 Automatic AA Gun (57mm), or SA-6 Gainful, or SA-8 GECKO, or possibly a combination of all three. The numbers of weapon systems of each per regiment or brigade is 24, 20, and 20 respectively.

An air defense battery is organic to each motorized rifle and tank regiment with usually one ZSU-23-4 platoon and one SA-9 GASKIN platoon assigned. There are four weapon systems assigned per platoon.

In addition to this formidable array of systems, the SA-7 GRAIL, a shoulder-fired missile, is scattered throughout the force structure.[18]

The list below illustrates those weapons which Soviet ground forces possess and can be employed against a heliborne threat.

		Max Range	Basic Load	Rate of Fire
7.62mm	Assault Rifle	400m	30 Rds*	600 RPM
7.62mm	Light Machinegun	800m	75 Rds*	600 RPM
12.7mm	Heavy Machinegun	100m	50 Rds*	600 RPM
14.5mm	Anti-Aircraft Machinegun	1,400m	4,800	600 RPM
23mm	Twin AA Gun	2,500m	2,400	1000 RPM
23mm	Quad SPAA Gun System	3,000m	3,000	1000 RPM
57mm	AA Gun System	4,000m	316	120 RPM

		Range		Altitude		
		Max	Min	Max	Min	No Msls Carried
SA-2	Guideline	40-50KM	-	27	1.5	1
SA4	GANEG	70	-	27	1.5	2
SA-6	Ganiful	30-35	4	11	.75	3
SA-7	Grail	3.5	-	3.5	.5	-
SA-8	Gecko	12.5	-	6.5	.5	4
SA-9	Gaskin	7	-	4.7	.2	4

*Magazine capacity

The 23-mm Quad SPAA gun system, the 57-mm AA system, the SA-6, the SA-8, and the SA-9 all are employed using radar technology which is quite sophisticated.[19] All radar are susceptible to jamming techniques however. This study will not go any further into this area as it is outside of the scope of the thesis.

Another significant threat exists in support of this tank battalion in the form of the tactical air forces. Air power is an integral part of the Soviet combined arms team and is called "Frontal Aviation." This frontal aviation is directly controlled by the Front commander and reinforced by Long Range Aviation (LRA) and Military Transport Aviation as required.

The mission of Soviet tactical aviation is to support the ground forces and this can be broken down into several basic tasks:

1. Gain and maintain air superiority in the area of primary operation.
2. Isolation of the battle area and restriction of enemy movement.
3. Provide air support to the ground troops in their combat actions.
4. Provide air reconnaissance for the ground troops.

5. Provide the ground troops with transportation in helicopter landing operations.[20]

The variety of on board weapon systems of both helicopters and fighter aircraft pose a significant threat to any heliborne operations an enemy may attempt. The Soviets train in air-to-air combat tactics with their HIND D helicopter, and also train attacking targets with helicopters in conjunction with fighter aircraft.

A significant combat power addition to Soviet tactical formations is the excellent capability the Soviets possess in all phases of electronic warfare (EW). During the October 1973 Israeli-Egyptian War, Egypt demonstrated that the Soviets have an extensive intercept capability for both radio and radar. These EW units are moved well forward with the leading field forces and possess the capability to intercept transmissions within the following distances from the FEBA:

Artillery Ground Radar: Approximately 25 kms

VHF: Approximately 40 kms

HF Ground Waves: Approximately 80 kms

HF Skywave: Unlimited [21]

Direction finding (DF) capability of the Soviet forces is equivalent to that of intercept and is acted on very quickly.

Soviet radioelectronic combat combines signal intelligence, direction finding, deception, suppressive direct and indirect fires, and extensive jamming in order to disrupt the enemy's means of command and control. The goal is to disrupt or destroy at least 50 percent of the enemy's communication systems during critical times preceding or during the battle. This very real potential the Soviets possess can certainly cause disruption for the communication link presently required for a successful launch of

HELLFIRE in support of the Mechanized Infantry Company facing this Soviet tank battalion.

Another facet of electronic warfare must be addressed, the possible countermeasures against the HELLFIRE missiles command fire to target link.

The forward observers GLLD and the autonomous laser designator is, of course, susceptible to laser detection. This detection is very difficult but it is highly possible to develop tactical laser detection and direction finding devices and their capability is postulated to be within Soviet technological capabilities.

Another threat to laser designators is the technique of highly concentrated rail jamming. Flicker jamming can also be used against the human element to cause the psychological effects of nausea and disorientation. This technique is particularly effective at night and during periods of low visibility. Spoofing is another means by which laser designators can be compromised. Mimicking the original pulse and simulate reflecting it from a different location than the intended target.

HELLFIRE's RF-IR mode is also susceptible to certain countermeasures. Soviet radar controlled AA guns have systems which automatically shut the system down once a missile launch is detected. These air defense systems are usually employed in groups of four or more with a highly centralized means of command and control. Once a missile launch is detected, all systems can "blink" or change frequencies to confuse the missile's guidance system. Dummy radar emitters can also be employed.

The IRIS mode can be confused by the use of decoys, smoke screens, and aerosol screens. Also the use of flares and fires are effective anti-infrared techniques available although not completely effective against an

imaging system which homes on specific heat signatures.*

As can be seen from the previous discussion, the current Soviet threat to a US mechanized company team in Central Europe in general and to HELLFIRE and the AAH-64 in support of that team in particular is not only extremely formidable, but this threat will grow in size in the very near future. US technology and doctrine must seek every advantage possible in order to capitalize on what we do have available.

*There are numerous proposed Soviet Electro-Optic countermeasure systems projected for development in the 1980-1990 time frame. For more information on this topic see The Threat to HELLFIRE, Jan 1979.

CHAPTER 4

DISCUSSION & FINDINGS

The employment of HELLFIRE in the indirect mode requires close coordination between the designator and the launcher involving an accurate exchange of large amounts of target data. This link must be EW resistant in order to decrease the effectiveness of an extensive enemy ESM capability.

Current data required by the Scout/Attack helicopter team from the forward observer laser designator operation, which are voice linked now, are:

Initial alert of the mission

Target coordinates

GLLD (FO's) location

Numbers and nature of the targets and the mode of attack (rapid/single)

Data that can be provided (voice link) by the FO to the attack team now are:

Initial alert of the mission

FO's azimuth to target

FO's range to target

GLLD location

Nature of target and requested mode of attack.

(The attack team must compute the coordinates of the target from this polar plot information.)

The downlink data to the FO required are:

The missile's laser code

Time of flight

When to designate

Communication and data uplinks and downlinks are the keys to command and control of the AH-64 equipped with HELLFIRE. Without an effective system of communication between the AH-64, scout aircraft and the forward observer (FO) with his laser designator the AH-64 must operate in the autonomous mode. This method exposes the aircraft to the extremely lethal firepower of the threat's weapon systems. The communication system for command and control must be designed to minimize potential enemy capabilities.

At present there are essentially three methods for control of HELLFIRE by the scout designator or FO designator when used in the non-autonomous indirect mode. These are:

FM voice exclusively

Digital data and FM voice

Digital data exclusively with FM voice use solely as a backup method of communication.

For digital data the current Digital Message Device (DMD) used with TACFIRE was employed, and can be coupled with any Standard Army FM radio. Test results have shown:

That with pure voice a mean time on the radio was 101.53 second with no transmission errors.

That with DMD and voice a mean time was 176.47 seconds with 14 errors.

That with pure DMD a mean actual on the air time was 22 seconds with no single transmission in excess of 6 seconds. There were 17 errors made.[22]

The conclusion was made from this study that use of the DMD employed with HELLFIRE is, in fact, valid although considerable modification must be made and extensive training accomplished.

As can be seen from these test results, survivability with regard to enemy interception and subsequent jamming or direction finding is greatly enhanced with use of a digital means of communication. As a matter of fact the FM voice network resulted in nearly six times the required on the air time deemed dangerous by TRADOC. FM voice communication is not suitable for the indirect fire mode of HELLFIRE and should be used as a backup only.[23]

As a result of these recommendations the US Army is currently taking steps to resolve these deficiencies. During HELLFIRE OT II there is a requirement to demonstrate target hand-off and successful engagement of targets using remote designation from either the GLLD operator or scout aircraft. The primary communication hardware for the FIST team is to be the DMD (AN-PSG-2) which is currently in production. A modification by the producer has incorporated a laser HELLFIRE format enabling a conversion of polar plot information to UTM coordinates and an internal clock. It was recommended that DMD also be modified to perform mathematical calculations (azimuth and time of flight) required in the indirect launch. These modifications will greatly reduce computation time.

The DMD in its present form is too cumbersome to be employed in the scout aircraft and no airborne data system exists. The US Army's position is, this system must handle multiple targets and other battlefield information as accurately and rapidly as present technology allows. "This capability is necessary to perform a HELLFIRE mission in the indirect mode."[24]

"At the present time DARCOM is embarking on a project which will, when used in conjunction with the AH-64 fire control computer, format digital target hand-off message for computation by the computer thus providing

instantaneous launch information to the co-pilot gunner. The system will not be available by AH-64 OT II. The follow-on airborne data transfer system (ADTS), of which the ATHS will be part, is part of the ASH required operational capability and will provide the scout team leader with the digital interface capability."[25]

The Airborne Target Handoff System (ATHS) will allow immediate transfer of target information, thereby allowing armored targets to be engaged with direct or indirect HELLFIRE missiles as soon as they are recognized. The system will improve the target servicing rate while decreasing the likelihood of enemy detection and/or jamming. The system will be capable of providing target information transfer during periods of intensive EW operations. The ATHS will consist of:

MIL-STD-1553 Bus interface

Radio (FM) interface

ATHS interface

Connecting hardware

The ATHS will interface with the following onboard systems of the AAH-64:

Mission computer

Necessary aircraft displays and controls

VHF-AM, VHF-FM, UHF, and associated COMSEC equipment

A HELLFIRE fire mission initiated by the airborne or ground laser designator will be transmitted to the missile launching helicopter and displayed on the combat crew members display. This message will contain initiator identity, target coordinates, description of target, and laser code. In response to the displayed message, the mission will be accepted or rejected by an appropriate entry into the data entry panel. Mission acceptance action will automatically cause the ATHS to acknowledge mission

receipt and to command the mission computer to compute time of flight and launcher to target azimuth. Time of flight will be transmitted to the laser designator who will acknowledge receipt. As a minimum the ATHS will be capable of accepting and initiating fixed format TACFIRE message. ATHS will accomplish all HELLFIRE information/target transfer now achieved by FM tactical voice communication systems. This system will substantially increase the efficiency of mission coordination and probability of successful target engagements by decreasing radio transmission time and errors, and minimizing detection.[26]

The US Army's position on the Airborne Data Transfer System (ADTS), which is to be included on the scout helicopter, is that it must also interface with the ATHS and TACFIRE through the DMD. The ADTS will consist of:

Keyboard for fire control

Display (6" CRT w/radar altimeter)

Microprocessor (integrated with the onboard Fire Control Computer (FCC))

Modulator/Demodulator (MODEM). This MODEM function is to provide the same capability that presently exists in the TACFIRE Digital Message Service (DMD).

Manual, automatic, and semi-automatic data handling display.

The Fire Control Computer (FCC) will be capable of taking range, angle, and position information from a GLLD and compute display, and/or output target location coordinates, automatically, semi-automatically, and manually. The FCC will also be capable of computing HELLFIRE footprints and safety algorithms, prior to assignment of targets by the ASH to the attack helicopters. Communications to and from the AH-64 or GLLD will be

automatically coupled to the laser designator to synchronize laser designation of targets for HELLFIRE and Copperhead.[27]

With the improved DMD, ATHS and ADTS a scenario on the Central European battlefield with the U.S. mechanized infantry company/team pitted against a reinforced Soviet tank battalion might be thus:

1. The organic FO identifies a T-72 tank and determines the range using GLLD.

2. The DMD converts GLLD data into the UTM coordinates for the T-72 tank.

3. FIST initiates "Fire Request-Laser" to the scout helicopter.

4. The scout moves an AH-64 from a loiter area by a NOE route into an attack position and orients the AH-64 on the attack azimuth without radio transmission.

5. The FO sends a digital fire message using the DMD to the AH-64's ATHS.

6. ATHS computes and relays the laser code and time of flight to the FO.

7. "Launch."

8. "Lase" light illuminates on the DMD and the FO designates with GLLD.

9. "Kill."

This entire scenario can occur within approximately 30 seconds if the AH-64 is already in attack position and if holding in a loiter area, the time is directly proportional to the travel time from this area to the attack position.

As can be seen from this particular scenario the forward observer is the actual controller of the aircraft and it is used as a means of fire

support. There are two schools of thought which exist in the Army concerning the employment of attack helicopters:

Attack helicopters are a means of fire support.

Attack helicopters are direct fire/maneuver in nature.

FM 6-29, Fire Support in Combined Arms Operations, describes various fire support systems available to the ground commander as field artillery, mortars, naval gunfire, and close air support. It also states that, when the situation dictates attack helicopters can augment these fire support means, but caution must be taken as use of these weapons for fire support removes them from their primary mission. Their full effectiveness is achieved as an aerial maneuver unit. Their inherent mobility to maneuver rapidly and mass fires in any type of terrain, regardless of wide battlefield dispersion, make attack helicopters an especially capable target attack means. They can provide a heavy volume of fire in terrain or in tactical situations that limit effective and economical use of field artillery, mortars, close air support, and naval gunfire. This doctrinal manual further states that when the appropriate commander decides to divert attack helicopters to a fire support role, the objective of attack helicopter employment is to put the aircraft on station at the right time with the right munition. This must be well coordinated since aircraft loiter time is limited and the enemy's air defense array is extremely lethal. Scheduled or on-call field artillery fires may be required to suppress enemy air defenses for the attack and to cover withdrawal after the mission.[28] Another means of employment may have close air support aircraft and attack helicopters working together as a team using field artillery fires again as suppression. This entire team is closely orchestrated by the various fire support elements at brigade and division level.

The movement of attack helicopters, close air support, and fire support must be carefully integrated so that neither one restricts the other while also providing mutual support.

"United States Marine Corps attack helicopters are organized into squadrons of Marine Air Wings and are employed purely as fire support. Engagements are directed by forward air controllers or by supported ground commander."[29]

The primary U.S. Army doctrinal manuals governing the employment of attack helicopters state that the mission of these units is to destroy enemy forces by aerial combat power using fire and maneuver as an integrated part of the combined arms team. These manuals do not address a fire support role even as a secondary mission although one states that an attack helicopter company may be given a "reinforce by fire" mission by a ground battalion task force in heavy contact.[30]

Another doctrinal manual on Army aviation states that "Attack helicopters perform traditional firepower tasks which in no way conflict or compete with tactical air support provided by other services."[31] This manual goes on to state that attack helicopters are combat maneuver units and should be employed in large numbers at critical points on the battlefield.

The doctrinal manual which covers armored and mechanized division operations describes attack helicopter units as follows: "They maneuver like ground units to engage enemy from the front, flanks, and rear."[32] This manual then goes on to state that attack helicopters may be used to suppress enemy air defense and field artillery fires.[33] This, of course, is a fire support counterfire mission controlled by the division artillery commander.

As can be seen, a large number of doctrinal discrepancies exist regarding employment of attack helicopters. This impact is addressed in the CINCUSAREUR report, Project MAXIMIZE, which states: "The lack of doctrinal materiel has fostered employment of attack assets in a fire support role, operating in fire support nets, and receiving mission taskings in the fire support annex of the division OPORD rather than utilization as a combat maneuver unit, completely integrated into the maneuver unit's scheme of maneuver and receiving mission taskings in paragraph 3 of the division OPORD."[34] It must be noted here that current doctrine does call for mission taskings to be addressed in paragraph 3 of the operations order.

More evidence exists regarding these discrepancies. "In a November 1978 combined arms live fire exercise (CALFEX) after action report the 2d Brigade, 4th Infantry Division, addressed the fact that attack helicopters have, in practice, been controlled by the company team commander, via the scouts. The report states that since FIST's are trained to handle all fire support, they should do so in practice, and that the FIST should be the element in contact with the scouts, in order to direct the attack helicopters. During an Infantry Conference held at Fort Benning in December 1978, the question of how attack helicopters are employed and controlled was raised. Consensus among general officers in attendance, including several division commanders, was that attack helicopters should be allocated and controlled by the division fire support element (FSE)."[35]

A great similarity does exist between traditional fire support means (field artillery, close air support, mortars, naval gunfire) and attack helicopters' they both constitute combat power on the battlefield. This combat power can be defined as firepower and maneuver. Whereas indirect

fire weapons gain their maneuver element from gunnery techniques, close air support and attack helicopters gain their maneuver from aerial flight. Attack helicopter contributions on the battlefield closely resemble those of close air support, and in fact, these two elements are employed together at times, complimenting one anothers potential. Close air support is allocated and controlled through fire support channels at division (FSE) while attack helicopter assets are allocated and controlled through maneuver channels (G-3).

These inconsistencies in doctrine coupled with the technological advances as discussed and the threat potential may lead one to ponder on how to best capitalize and effectively integrate these complex but extremely lethal systems.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Upon analyzing all data researched it is doubtful that the full potential of the Advanced Attack Helicopter employing the HELLFIRE missile can be realized using the current systems and doctrine. As stated from the outset, in order to maximize the effectiveness of this weapon system it must be closely controlled and carefully integrated into the overall battle plan. Then how is this target servicing role to be accomplished from both a technical and tactical aspect taking target analysis, target priorities, and survivability into consideration along with command, control and communication techniques. A new method must be examined and that method will be proposed in this chapter.

The current attack helicopter armed with the direct fire optically tracked wire guided missile (TOW) is best employed through maneuver command channels as a highly mobile antitank strike force. However, this helicopter has severe limitations. It must visually track the weapon for the entire flight, remaining exposed itself and therefore survivability is questionable. The missile is limited to 3740 meters and fired using direct fire so when employed it is usually to reinforce a task force and must have visual contact with its target; servicing those targets which pose the immediate threat directly opposite the ground commander's forces.

The capability the HELLFIRE possesses now allows the AH-64 to engage targets at much greater ranges without exposing itself to visual or radar detection. In the laser mode it relies on an external source to guide the weapon and the other modes are fire-and-forget. All modes can employ the fire and forget fire technique, as far as the launch platform is concerned.

This technique enhances survivability considerably and coupled with the IRIS and RF/IR capability of HELLFIRE this attack helicopter can now service targets such as lead elements of second echelon regiments, air defense weapon systems, EW systems, command posts in the first echelon, and even self-propelled artillery in the Regimental Artillery Group (RAG). This capability must be realized and even exploited while still retaining the mission of rapid reinforcement at the critical point of decision. In the defense the AAH can attack targets while the entire battle is developing rather than being held in a reserve role, as now is usually the case, waiting for the enemy's main attack to develop. It can be used to influence where the main attack will come prior to commitment of the second echelon regiment.

Now, what is the source of the target information necessary for the crew to act on? The most timely and accurate data bank of target intelligence available is TACFIRE. This system can sort out and select, in accordance with the commander's priorities, the best means of engaging specific targets without duplication of fire support effort. TACFIRE is also capable of the execution of fire support functions pertaining to the integration of close air support into fire support planning. As stated previously, TACFIRE has the ability to convert standard message to digital messages in a secure mode with burst transmissions to enhance survivability. The Airborne Data Transfer System (ADTS), when fielded, will allow the AAH and ASH to communicate digitally with TACFIRE and the forward observers digital message device. This communication link must be present in order to capitalize on the inherent capabilities of both systems.

When using the AAH weapon system in this mode it must be managed by fire support personnel while still retaining the maneuver mission at the

time of need. Within the framework of a maneuver force, fire support coordination facilities exist at every echelon, from the FIST at company level to the FSE at corps level. Fire support coordinators are charged with actively injecting fire support into the commander's estimates, decisions, and concepts. Fire support communications channels are used to forward requests for fire support to higher echelons and ultimately to a fire support delivery agency. This agency can be attack teams of AAH's and ASH's loitering in masked positions awaiting fire missions. These teams would move into position after the situation has developed sufficiently that the ground commander is satisfied that an adequate array of targets are available for attack. The request is entered into fire support channels by fire support personnel in response to the supported commander's decision. The communication link between TACFIRE and the AH-64's ADTS carries the information of which targets to engage in line with the commander's priorities. These actions can occur during the covering force battle or the main battle since attack helicopters are a highly responsive means of combat power.

What must be overcome in this particular scenario is the fact that the roles of maneuver and fire support the attack helicopter now has, as primary and secondary missions, respectively, must be reversed for the AH-64 armed with HELLFIRE. The secondary mission, or better, "another mission," the AH-64 would have is the same as attack helicopters have now; massing to destroy or disrupt enemy armor and mechanized forces by aerial firepower. In the defense this is usually at the point of the main attack during the attempted breakthrough.

Let's examine the best method by which to accomplish this. The main actors are AAH-HF, scout aircraft, FO GLLD, and TACFIRE. The communication

network has digital links between all actors. In this scenario our company/team in central Europe is part of a mechanized infantry battalion task force opposed by a tank regiment in the first echelon and is in the area of the enemy's main attack. Because of this, the enemy's second echelon regiment is following in our area. Let's assume the covering force has marginally accomplished its mission and as the first echelon regiment closes on the MBA, the second echelon regiment moves forward for commitment.

Intelligence assets are feeding information into TACFIRE about the disposition of the first echelon and sporadically about targets being detected from the second echelon regimental elements which are now seven kilometers away from the forward battle positions. This information is coming from RPVS, SOTAS, FAALS, and other intelligence sources.

The brigade commander sees now what is occuring and decided to employ the attack helicopters he has in support. He directs his brigade FSO to move the attack teams forward with priorities of first echelon RAGS and air defense assets and second echelon forces. He has decided that the battalion task force can deal with the first echelon maneuver force target array it faces without attack helicopter assistance.

The brigade FSO transmits the warning order, using his VFMED, through TACFIRE to the supporting teams. TACFIRE then analyzes the requirements, determines missions suitable, and sends the information to the scout via digital communications. The scout acknowledges, stores the fire data and alerts the AH-64. He then assigns the mission, transmits the fire data and assigns the fire station (attack position) to the AH-64. The AH-64 moves into position, selects the laser or RF/IR seeker mode missiles and programs the missiles for target location and indirect

fire. He then launches while remaining masked using either singular, rapid, or ripple techniques.

The first echelon's attack becomes halted and the second echelon has experienced numerous casualties from HELLFIRE. The enemy commander rushes the second echelon forward to increase the tempo and his chance of success. The initial second echelon forces are detected 4-5 kilometers from the front line troops. The FO GLLD has acquired targets and transmits the mission alert to the scout. The scout immediately assigns the mission and a fire station to the AAH/HF and instructs the crew to establish direct communication with the FO GLLD. Using digital communication the AAH/HF acknowledges and requests mission information from the FO GLLD while enroute to the fire station. Upon reaching the fire station the laser code is selected and the missile is programmed for indirect launch from that position. The selected code is transmitted to the FO GLLD and the missiles fired while the helicopter is protected by masking terrain. The missile time of flight is computed and prior to impact a "LASE" message is sent to the FO GLLD for target designation. During this attack mode,again, either singular, rapid fire, or ripple fire techniques can be used.

The laser mode is an absolute necessity for this particular mission of the AH-64. To attack armor targets which pose an immediate threat to the task force commander is best accomplished by FIST members using laser designators. This allows prioritization of targets or sectors by the commander and resolves duplication of target servicing.

Using fire support channels of communication the command nets remain open for maneuver force coordination and the additional burden of

directing and coordinating additional assets are relieved from the maneuver commander. This responsibility is placed in the hands of personnel who are trained in allocating and coordinating close air support, and in many cases attack helicopter and close air support aircraft will have to work together in order to complement one another.

One can readily see from these above proposals that the role of the attack helicopter will not be changed considerably. The major point being is the need to exploit the capabilities of the HELLFIRE missile by linking it with a communication system which can interface with a target intelligence source. This link must be rapid for the weapon system to be responsive and survive on the battlefield. The FO GLLD must be able to communicate digitally, using the DMD, with the attack team in order to fully utilize the armor killing capability of the HELLFIRE missile at the point of decision. The scout and attack helicopters must be able to remain masked as much as possible utilizing terrain considering the formidable air defenses the threat possesses.

With these minor doctrinal changes and insuring compatibility of systems with technological advancement the U.S. Army can have a weapon system with its capabilities fully utilized which can most definitely influence the outcome of future battles. The leaders of our forces will have a system where those planning and employment techniques will allow them to manage the battlefield more effectively and fully exploit the lethality of HELLFIRE.

It is recommended that a re-thinking process occur in the U.S. Army with regard to employment tactics of the AH-64 coupled with HELLFIRE in all phases of both offensive and defensive operations. The process must occur prior to accepting the equipment in the field.

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APPENDIX A

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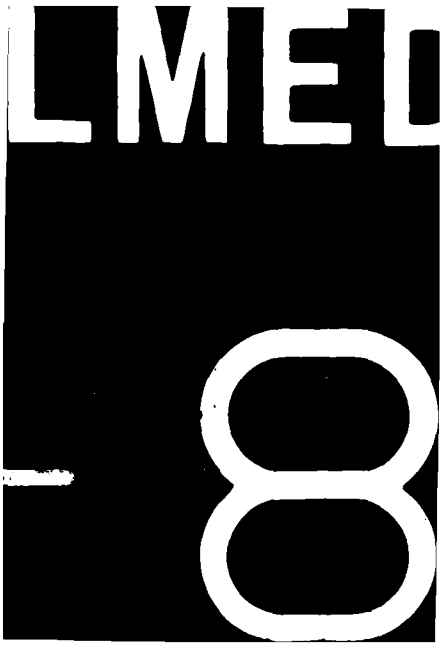
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8